Osteopathic Approach to Head Injury

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Disclaimer:

- I have no conflict of interest to report regarding this topic.
Educational Objectives:

- Appreciate early management of Traumatic Brain Injury and common persistent symptoms.
- Understand how recent Evidence Based Research supports the use of OMT in patients with head injury.
- Understand the Indications & Contraindications for OMT in Patients with Head Injuries.
- Be able to use this knowledge to plan an OMT session for a patient with head injury.

Introduction:

- Head Injuries:
  - Can be massive, +/- open with fractures or large hematomas or
  - “Minor” with
    - small but critical hemorrhage
    - diffuse swelling from contusion
    - rapid stretch of nerves esp long axons, causing a shearing type injury with neural disconnections like overstretching a co-axial cable-called **Diffuse Axonal Injury**
Most commonly from MVAs, Assault, Sports Injuries, Falls, Blast Injuries in war.

Such injuries will require, rest and proper environment w nutrients for healing.

~70% recover fully in 6-12 mo; 30% will recover more slowly or not at all.

An Osteo Approach can play a major role in the recovery of such patients.

Medical Care:

Early-Acute-

Stabilization in the field, then

ED+/- Surgery, Neurosurg, Ortho, Induced Coma
Medical Care:

- **Intermediate-Subacute** - Secondary Evaluation (Neuro, PM&R)

- **GOAT** (Galveston Orientation & Amnesia Test) Score for TBI:
  The lower the score, the longer the patient will need to recover; the higher the score, the more likely the patient is to fully recover.

- **Careful Hx & PE** to look for more subtle injuries missed during lifesaving phase of Tx

- **Neuropsych Testing** +/- Brain Mapping - ID functions of the brain affected by areas of the brain injured - use to identify needs for therapies, accommodation and strategies for success

- **Therapies** as determined by specific need - PT, OT, Speech/Swallowing, Brain Retraining, Counseling

- **Role for OMT including Cranial**
Scoring the GOAT:

Appendix 1: Instructions for Scoring the GOAT

Questions:
1. Assign 2 error points if patient fails to state first and last names correctly; 4 points if patient fails to state date of birth correctly; 6 points if patient fails to state town of residence (street address is unnecessary). A maximum of 30 error points could be scored and entered in the two columns on the extreme right side of the test form (Figure 1).
2. If the patient is unable to state the town he is in at the time of the assessment, 5 points are scored.
3. Five error points are scored if the patient is unable to recall the date of admission; 5 additional points are deducted if the patient fails to describe accurately the mode of transportation to the hospital.
4. Five error points are given when the patient is unable to recall the first event after injury (e.g., waking up in hospital room). Patients who cannot recall an event after the injury would have 5 additional error points deducted because of failure to present details of such an event. These patients who describe a verifiable or at least plausible post-traumatic event, but are unable to provide details, would receive 5 error points on this question.
5. Criteria for scoring responses are similar to those used in question 4. Two error points are deducted for vague recall of an event prior to the injury (e.g., driving a car shortly before the accident), whereas 5 additional points are deducted for total failure to recall any retrograde event.
6. Score 1 error point for each half hour that the patient’s response deviates from the correct time, up to a maximum of 5.
7. Assign 1 error point for each day that the patient’s response is removed from the correct day of the week.
8. Score 1 error point for each day of the month that the patient’s response deviates from the correct date, to a maximum of 3.
9. Five error points are deducted for each month that the patient’s response is removed from the correct month, to a maximum of 15.
10. Ten error points are deducted for each year that the patient’s response deviates from the correct one, to a maximum of 50.

Computation of GOAT Score:

Enter the total error points accrued for the 10 items in the lower right hand corner of the test form (Figure 1). The GOAT score equals 100 minus total error points.

Patient & Family Education & Support:

- **TBI-condition, expectation, support groups**
- **Symptomatic Tx:**
  - **N/V-hydration, food choices (avoid incr inflammation from mega carbs), Rx**
  - Sensitivity to light, sound-decr light(esp LED) & sound-tinted glasses, hat, ear plugs or permission to use ipod at school in background to decrease stimulation
  - Hypersens to stimulation-avoid /limit TV, computer, even texting for initial days at home, sit in front of the class
  - Insomnia-sleep hygiene, Rx pm
Patient & Family Education & Support:

- **Symptomatic Tx:**
  - HA & other Pain
  - Cognitive/Learning Difficulties: accommodations - more time, quiet environment, check in at end of class w teacher to confirm assignments & get support

- **Be Vigilant for delayed worsening of Sx:** esp in 4-6 weeks post injury
  - Worse N/V, HA, trouble conc, sleep, appetite or new neuro sx, such as loss of speech or strength of a limb
  - Call 911 for return to ED for reevaluation - Can be a rebleed or clot dissolution with larger bleed

- **Sudden Impact Syndrome:** Avoid another concussion - helmet, avoid contact sports

Medical Care:

- **Late-Chronic:**

  - The Role of **Diaschisis** - ie, when one part of the brain is injured, other dormant areas (sometimes quite distant from the injury) awake / are expressed
  - Can be used early on in therapies to build new pathways for lost functions
  - Can result in changes in personality (shy to outgoing), interests (reading to theater & dance), skills, even tastes in food, clothing style, life goals
Medical Care:

- Continue goal setting and strategies for achievement
- **Role for OMT including Cranial**
- Continued Therapies as needed until stable
- Psych-Anxiety, Depression, PTSD, Impaired Sleep

Pathophysiology of Brain Healing supports Principles of Osteopathy

Magnetencephalography (MEG) imaging shows brain scans of a patient with traumatic brain injury (TBI). Areas in pink and purple show reduced connectivity between parts of the patient’s brain.

Osteopathic Tenants

- The body is a whole
- Structure & Function are interrelated
- The body has the ability to maintain or restore Homeostatic balance
- Osteopathic Treatment is based on the rational application of these principles

Current Focus of Brain Injury & Healing Research:

- **Diffuse Axonal Injury** - takes time to reestablish new connections
  - Osteo: antegrade & retrograde axoplasmic flow of CSF in nerve sheaths

- **Decrease Hyperstimulation of SNS** - fight or flight
  - Osteo: Balance the ANS—decrease SNS & increase PNS (rest & digest)
  - SNS-Cervical & Thoracic-SNS chain ganglia, Trigeminal (CN V)
  - PNS-Cranial & Sacral-suboccipital-esp Vagus (CN X)
Current Focus of Brain Injury & Healing Research:

- Increase blood flow to & from the affected area:
  - Osteo: The Rule of the Artery is Supreme
  - O2 & nutrients in, CO2 & waste products out
  - Pro vs Anti-inflammatory cytokines, Nitrous oxide pathway

- Enhance lymphatic clearance of damage:
  - No medication that targets lymphatic flow
  - Lymphatic flow rate via lymphangions-controlled by SNS
  - Recently discovered glutamate dept. alternate pathway for direct recycling CNS to lymphatics - Glymphatics
  - Osteo- OMTa strong tool to enhance lymphatic flow & return

- So... Open the Thoracic duct, remove impediments to flow, esp to tight distorted fascia & the facilitated SNS, restore the lymphatic pumps, and pump away!

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Prevailing Theory of CSF flow:

- CSF is secreted by choroid plexi in the cerebral ventricles
- Travels by pulsatile flow through ventricles
- To the 4th ventricle
- To the subarachnoid space via the foramina of Luschka and Magendie
- Reabsorbed via arachnoid villa/granulations
- Phase contrast MRI can visualize CSF flow dynamics
Lymphatics in the CNS?

- Small molecules and hydrophobic compounds can cross the blood-brain barrier (BBB)
- Peptides and proteins can’t cross the BBB
- If CSF flow/diffusion was the only method to clear cellular waste, it would take >100 hours
Glymphatics

- Glial cells support and protect the neurons
- Maintain homeostasis by supplying nutrients and removing wastes
- Participate in neurotransmission
- Lymphatic system recently discovered within the brain regulated by glutamate dept. Aquaporin-4 water channels among the astrocytes
- Injury to the brain parenchyma causes astrogliosis and an increase in AQP-4 activity

Glymphatic Theory

- A large proportion of CSF circulates
  - in the subarachnoid space,
  - through brain parenchyma,
  - along paravascular spaces
  - exchanges interstitial fluid
  - CSF-ISF interchange then to lymphatics
  - via glutamate dept. astrocytic aquaporin-4 water channels
  - Based on in vivo and ex vivo imaging
Implications

- Injury to the brain parenchyma causes astrogliosis and an increase in AQP-4 activity.
- Rats with genetic altering that reduces AQP-4 levels have 70% less clearance of solutes than normal rats.
- Testing amyloid-B in AQP-4 null rats lead to a 65% decrease in clearance compared to normal rats.
- Could this delayed clearance be a contributing cause of Alzheimer’s or other neurodegenerative diseases?

Normal CSF vs CSF Flow in Hydrocephaly - What would it look like after Cranial OMT???
Current Focus of Brain Injury & Healing Research:

- Critical role of sleep in healing-
  - The brain needs to sleep to rest, regenerate & heal
  - Central sleep apnea
  - Cranial OMM helps the brain rest- **induce Still Point**, removes restrictions to flow of the CSF, decrease SNS

- "Idling Neurons" can be recruited under certain conditions- 1990s Decade of the Brain

- Neuropathic Medications - down regulate chronic pain C fibers especially at the dorsal horn of the spinal cord- Neurontin (gabapentin), Flexeril (cyclobenzaprine) etc.

Recommendations- see links below

- Clinical Guidelines

- Lessons from the Military

- Profession Sports-NFL & Concussions
- Clinical Guidelines Concussion: VA/DOD:
t=t&q=&esrc=s&sa=U&ved=0CB8QFjABahUKWEwjaflOifHfIAhXNK4qKHF
c9oAzo&sq2=5XK5b9QUgfoY2WfCOCmA&usg=AFQjCNNG6Nu7k2yuQMOLuh251Fcx5EYq4A

- Heads Up to Clinicians: CDC Clinical Guidelines 2009:
icians_guide.html&rct=j&q=&esrc=s&sa=U&ved=0CCUQFjACahUKEwjaflOifHfIAh
XNK4qKHC9oAzo&sq2=kv39hgz2mFseZbxWq23qTd&usg=AFQjCNHemaHVcfwhzbfYHinKF8BXBFjLw

Sports Concussion Toolbook: American Academy of Neurology:

fr=esrc=s&sa=U&ved=0CCwQFjADahUKWEwjaflOifHfIAhXNK4qKHC9oAzo&sq2=e20et7j08YLLQC
WPzZbfvA&usg=AFQjCNEOh96eWFkhir33web4W_vyGAbhSA

Ontario Neurotrauma Concussion Guidelines 2013:

&fr=q&esrc=s&sa=U&ved=0CEoQFjAJahUKWEwjr2MnOhjHAhVQmMgKHV078L0&sq2=I
qu6EcE0e8sJmknkCpZzw&usg=AFQjCNEObmbl8kV32CRtX2h0k377XMa9w
NIH Rehab Management of Concussion:
&rct=j&frm=1&q=&esrc=s&sa=U&ved=0CB4QFjAbahUKEwj4mLqliPjHAhXGNJgKHYhbCY0&sig2=hPNa1z9pBvh8WL4Ugnaw&usg=AFQjCNGeprN5LwaHxgxg40ZyYNH2p6B4uscQ

NIH Clinical Practice Guidelines for mild TBI:
&rct=j&frm=1&q=&esrc=s&sa=U&ved=0CBkQFjAAahUKEwj4mLqliPjHAhXGNJgKHYhbCY0&sig2=g_778Rfj3qD-PgzYuWOMw&usg=AFQjCNHMZUdQh4XCyYhPHB8ATxq0hvHdNQ

Indications to OMT in Head Injury:

- **Persistent Post Concussive Sx** during Sub Acute or Chronic Stages:
  - Headache & other Pain Syndromes
  - Hyper sensitivity to stimulation, light & sound
  - Nausea & Vomiting
  - Anxiety Depression or PTSD
  - Cognition & Memory Difficulties
  - Insomnia

- **Functional Bowel Disorders** common – effects of ANS & Myofascial Imbalances, shared neurotransmitters between the brain & the gut
### Frequently Used Diagnosis

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<th>ICD-10</th>
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<td>Headache as Late Effect of Brain Injury</td>
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<td>Late Effect of Old Head Injury</td>
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<td>S09.90X5</td>
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<td>Late Effect of Intracranial Injury</td>
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<tr>
<td>Post Traumatic Stress Disorder (PTSD)</td>
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<td>Sleep Disorder/Disturbance</td>
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### Contra-Indications to OMT in Head Injury:

- **During Acute Stabilization & Medical Treatment**

- **Acute Fracture Head or Neck, Hemorrhage, CVA, increased ICP**
An Osteopathic Approach - Use the Tools in YOUR Tool Box

Address 4 components:
- SNS
- PNS
- Lymphatic
- Facilitated somatic structures

An Initial Approach & Sequence: see Demo - Something for each of the 10 regions:

- **Thoracic Inlet**: MFR
  - Balance the Myofascia
  - Open the Lymphatic ducts

- **Cervical**: MFR- oscillatory rhythmic dMFR to 3 primary fascial layers:
  - Prevertebral fascia - deep investing of muscles - soft tissue + rhythm
  - Pretracheal (visceral) fascia - between SCM & trachea, hyoid
  - Superficial (Anterior) fascia - platysma, chin to sternum

Littlejohn Techniques, from Christian Fossum, DO (Norway)

- **Shoulders/ UEs**: Myofascia - MFR/SCS via extended arm to the scapula as a lever arm
- **Lumbar**- paraspinal muscle inhibition via lateral traction

- **Abdominal Diaphragm Release**- TOC - I like Still concept of using compression or distraction then move Indirect-to-direct-to-neutral

- **Rib** raising with indirect MFR over Rib Heads to decrease stimulation of the SNS chain ganglia beneath them-esp T1-T4 which give SNS to the Head & Neck

- **Pelvic Diaphragm** Release- Still concept applied to **Innominate** Rocking

- **Sacrum**- TOC-I like Lumbosacral decompression & CV4-enhances PNS via pelvic splanchnics

- **Hips/LEs**- Myofascia- MFR/SCS via extended leg w rhythm-follow psoas up to the abdominal diaphragm

- **Cranial**-
  - Suboccipital Release w Condylar Decompression- to balance ANS, incr ROM
  - Compression of the 4th Ventricle (CV4)- to enhance flow of CSF and quiet the brain via inducing a Still Point
Later Areas for Focus of Tx:

- **Myofascial Pain Syndromes**: SCS, BLT, MFR, TP injections if severe
- **Ribs**
  - Inhaled-by big breath at impact-maintained by SNS-ME, SCS,MFR
  - Sternal compression
  - Other rib dysf.-dept. on the direction of impact
- **C, T, L spine**: Paraspinal mm throughout:
  - SCS- esp A/P C1-C3, SCM,TRAP. Ls cap, Scalenes
  - Muscle Energy-Treats 3 for 1-muscle, joint, lymphatics
  - Still Technique, FPR, LAS-rapid, help retrain proprioception

Cranial:

- **Fluid**:
  - Venous Sinus Drainage Release w Occ Condylar Decompression
  - CSF-CV4- occiput & sacrum, V-spread
  - Spheno Palatine Ganglion Decompression

- **Dural**:
  - Torsion (named for free side) compression of Middle Meningeal a, on contralat side-common with Migraine Headache
  - SBS Decompression
  - Balanced Membranous Tension (BLT) of Dural Strains
  - Parietal & Frontal Lift

- **Articular**:
  - Direct Articular Release-esp Occipital Mastoid Suture, Parietal Notch, Spheno-Squamous pivot
  - Ethmoid Vomer Rocking
  - Sacral Intraosseous Compression
Cranial:

Nerve Entrapments:

- **Occiput**:
  - **Occipital Neuralgia** - Greater (C1)/Lesser (C2) Occipital
  - CN XII-Hypoglossal - Nausea, Vomit, GERD

- **Visual Sx-Sphenoid** (CN II, III, IV, VI, V1) balance 2
  fascial planes-orbit & globe, Occiput re visual
  processing, bones of the orbit

- **Anosia/Dysnosia** - CN I-Ethmoid Vomer, Frontal
  compression
Cranial:

Nerve Entrapments:

- **Temporalis:** nearly everything else!
  - CN III, IV, VI-Vision-EOMI
  - CN V- Trigeminal neuralgia, TMJ
  - CN VII-Facial n, Pain muscles of facial expression
  - CN VIII-Vestib-Cochlear- Tinnitus, vertigo, hearing loss
  - CN IX- Swallowing, taste
  - CN X- Vagus n- Nausea, swallowing, IBS, bradydysrhy
  - CN XI- Spinal Accessory- Spasm SCM & Trapezius

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**TMJ:**
- **Internal Joint Derangement:** ligamentous injury results in instability-articular disc displacement- abN forces on closing
- **Muscles of Mastication Imbalance:** esp Med & Lat Pterygoids (CN V)
- **Malocclusions**
- **Obstructive Sleep Apnea:** mandible driven posterior blocks oral pharynx
- **TMJ DDS** bite splints
Visceral:

- **SNS Abdominal Ganglia**: dorsal & ventral inhibition
  - Celiac (T5-9) UGI - heartburn, GERD
  - Sup Mesenteric (T10-11) Sm Int - bloating, gas
  - Inf Mesenteric (T12-L1) Lg Int - IBS, dia, constip

- **Mesenteric Release**: vasc, lymph, nerve-duodenum to sigmoid
- **Liver & Splenic Pump**: decrease congestion, increase clearance
- **Chapman’s Reflexes**: Neuro-Lymphatic - SNS & lymph
- **PNS**: decompression - suboccipital, lumbosacral, coccyx

Extremities:

- As dictated by involvement in injury or compensatory patterns
**Take Home Points: TBI**

- We will see more often in Primary Care—esp w return of military

- **No way to predict** whose Sxs will clear or stay-
  In general the more severe the Sx at onset, the longer they will take to clear

- **If Sx are prolonged, get NeuroPsych Testing** to ID deficits to guide therapy & accommodations

- Help patient be preventative—**Avoid Second Impact Syndrome**

**Take Home Points: TBI**

- **Research on Pathophysiology supports Osteopathic Principles** of:
  - Balancing ANS
  - Enhancing Circulation & Lymphatic Return
  - Quieting the CNS so it can rest to heal

- As DOs we have a powerful ability to **enhance the Quality of Life** for these Pts-
  - be willing to be their **Advocate**—write notes for medical necessity-help them win!
  - be willing to use your special knowledge & skills as an Osteopathic Physician!
References:

- Cuccurullo, S, Physical Medicine & Rehabilitation Board Review, Demos Medical, 2015.
- Personal communication, Hope Voto, DO, PM&R, Fellow Pediatric PM&R, U of Michigan.
- https://www.ucsf.edu/news/2013/05/105821/imaging-technique-could-help-traumatic-brain-injury-patients (picture on cover slide)

- Beneviste, H, Modern CSF flow research and Heinrich Quincke’s seminal 1872 article on the distribution of cinnabar in freely moving animals, J Comp Neurol, 2015.